



Ecological Monitoring Methods Handbook for the Rocky Flats, Colorado, Site

September 2008



U.S. Department
of Energy

Office of Legacy Management

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Predecisional Draft

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1.0 Introduction

The Rocky Flats Site (Rocky Flats) is under the jurisdiction of the U.S. Department of Energy (DOE) Office of Legacy Management (LM). S.M. Stoller Corporation conducts long-term surveillance and maintenance activities at Rocky Flats under the Legacy Management Support contract. Ecological monitoring is conducted as part of the surveillance and maintenance activities, which include activities conducted pursuant to the Rocky Flats Legacy Management Agreement. That agreement established the regulatory framework to implement the final response action selected and approved in the Rocky Flats Corrective Action Decision/Record of Decision under the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and recovery Act; and the Colorado Hazardous Waste Act to ensure that the response action remains protective of human health and the environment.

The *Ecological Monitoring Methods Handbook for the Rocky Flats Site* is provided as a general guidance document that outlines the methodology that was used through closure and since then for the ecological monitoring conducted at Rocky Flats. As with all monitoring, information needs should determine the type of methodology used. As new information needs arise and new methodologies are used or developed to collect the information needed at Rocky Flats, this handbook will be updated.

2.0 General Vegetation Monitoring—Qualitative

2.1 Revegetation Area Qualitative Assessment

Purpose: This method provides a qualitative assessment of revegetation success to evaluate the success of revegetation establishment, note problems, and suggest management strategies.

Location: For revegetation areas throughout the Central Operable Unit.

Time: Conducted during height of the growing season and other selected times (e.g., when specific weed species are present).

Equipment needed: Field notebook or qualitative assessment forms.

Any of the following may be recorded:

- List of seeded species present. Additional species present.
- Quality of revegetation establishment. Problems?
- Erosion control problems.
- Weed issues.
- Potential and needed weed management actions.
- Resource management needed, if any.
- General counts of shrubs and trees, as appropriate or required.

2.2 Weed Mapping Surveys

Purpose: This survey documents the distribution and density of selected noxious weeds on site. Noxious weeds are defined under the Colorado Noxious Weed Act. The Colorado Department of Agriculture typically updates this list annually. The species on this list and others considered problematic at Rocky Flats may be mapped. Not every noxious weed species occurring at Rocky Flats is mapped.

Location: Sitewide.

Time: Conducted while species of interest are flowering or highly visible.

Equipment needed: Vehicle; binoculars; a blank 44- × 34-inch base map of the site with landmarks and contour lines; red, green, yellow, and blue markers or pencils; PDA with ArcPad.

(**Note:** Individual maps may be produced for each species of interest. The actual species to be mapped will be determined annually.)

- Classify infestation areas into general density categories of high, medium, low, and scattered based on a subjective interpretation of the extent, visual density, need for control, and aggressive nature of the species.
 - *Red*: high density. In general, use a high-density category to indicate an area that is dominated by a nearly solid infestation or very high cover of the species being mapped.
 - *Blue*: medium density. Use a medium-density category where the infestation provides less cover and is less homogeneous than the red distribution of the species.
 - *Yellow*: low density. Use the low-density category where individuals of the species are present in fewer numbers and are not visually dominating the landscape but are beginning to establish a foothold in the community.
 - *Green*: scattered. The scattered-density category indicates an initial infestation or sporadic occurrence of the species in an area.
- While driving or walking across Rocky Flats, locate the weed species of interest.
- Using colored pencils or markers, mark the locations and densities of the species of interest on the map or enter this information into ArcPad using a PDA.
- After collecting the field data, enter the data into the Geographical Information System (GIS) database; conduct quality assurance (QA) on the data prior to analysis. Analysis consists of producing a weed map for each species and calculating the overall extent of infestation for each density category and on Rocky Flats as a whole.

2.3 Rare Plant Surveys

Purpose: This survey documents the status of rare plant species that occur at Rocky Flats (based on species listed as rare and imperiled by the Colorado Natural Heritage Program).

Location: Previously known locations of these species at Rocky Flats.

Time: Conducted while species of interest are flowering or highly visible.

Equipment needed: Location maps, field notebook, pens, PDA with ArcPad.

Species monitored: Rare plant populations to be monitored on site include the following:

- Forktip three-awn (*Aristida basiramea*)
- Carrion flower greenbriar (*Smilax herbacea* ssp. *lasioneuron*)
- Mountain sedge (*Carex oreocharis*)
- Dwarf leadplant (*Amorpha nana*).

Species monitored may vary depending on the rankings determined by the Colorado Natural Heritage Program.

- Locate the species of interest and evaluate the health and quality of the populations.
- Note any issues or threats to their continued existence.
- Record any suggestions for management of the species.
- Document and map any new populations of a rare species.

2.4 Photographic Documentation:

Purpose: This method documents and evaluates changes in natural and revegetated areas on site through time using repeat photography.

Location: Coordinates for the photo-point locations are maintained in the GIS database for Rocky Flats. The GIS can be used to generate maps for field use and to print out *x,y* coordinates for locating the points in the field. **Note:** Additional photo points may be added at any time.

Time: Varies depending on when last photos were taken or what information is required.

Equipment needed: Vehicle, maps of photo-point locations, photo-point coordinates, Global Positioning System (GPS) unit, series of photos from previous years, quadrat (size: 0.5 square meter [m²], shape: square, or other size/shape as needed), compass, a placard (whiteboard and marker or blackboard and chalk), digital camera.

Landscape views:

- Using photo-point map, GPS coordinates, or previous year's photos, locate the photo-point location in the field.
- Position the camera above the rebar or photo-point location (i.e., stand over the point).
- Using previous year's photos, determine the direction of the photo and the framing needed to match up with previous photos. Some zoom adjustment may be necessary depending on camera type.
- Take the photo.

Photo quadrats:

- Using photo-point map, GPS coordinates, or previous year's photos, locate the photo-point location in the field. At most locations, there should be a piece of rebar in the ground with a metal tag on it with the photo-point identification information.
- Place the quadrat frame on the ground with the rebar located at the southwest corner of the quadrat.
- Use a compass to orient the quadrat sides north-south and east-west using true north.
- Place a placard showing the date and identification code of the quadrat just outside the quadrat frame. Place the placard on the south edge of the quadrat facing south. Angle the placard such that the information is easily readable.
- Take the photo standing on the north side of the quadrat facing south. Using the previous year's photos, frame the photo appropriately and take the photograph. Take the photographs from directly above the quadrat while standing on the north edge, semi-straddling the edges of the quadrat.

Download and manage the photos in the Rocky Flats photo file structure.

2.5 Vegetation Mapping

Purpose: This method is used to map vegetation on site. The mapping may be conducted for a variety of reasons, such as updating the Rocky Flats vegetation map, mapping weeds (see Section A2, “Weed Mapping Surveys”), and classifying vegetation and rare plants.

Location: Sitewide.

Time: When appropriate for information needs.

Equipment needed: Vehicle, binoculars, a blank 44- × 34-inch base map of the site with landmarks and contour lines, acetate overlays, markers or pencils, PDA with ArcPad, GPS unit.

- Map vegetation according to the specifications required for the information needed.
- Map vegetation on hard-copy maps (possibly with acetate overlays), or use a PDA with ArcPad, or use a GPS unit.
- While driving or walking across Rocky Flats, identify the vegetation according to the classification scheme being used.
- In the field, enter the polygon, line, or point locations and classification of the vegetation type on hard-copy maps, PDA, or GPS unit.
- After collecting field data, enter the data into the GIS and conduct QA prior to analysis.
- Produce maps.

3.0 General Vegetation Monitoring—Quantitative

3.1 Belt Transect

Purpose: This method is used to determine species richness and frequency in an area.

Location: Across Rocky Flats according to information needs.

Time: Conducted during the height of the growing season or as feasible, depending on information needs.

Equipment needed: Metric measuring tape (at least 50 m long), a meter-long stick, field notebook or data sheets, pens, rebar or some type of stakes to mark transect endpoints, PDA.

- Locate transect locations. For new transects these are typically located randomly.
- Using a measuring tape, lay out a straight, 50-m transect line.
- If needed, use stakes or rebar to mark transect endpoints. Pin flags can be used to secure measuring tape in place so tape can be stretched and flattened out to mark transect.
- Record by species all species rooted within 1 meter of the transect (measuring tape) on either side of the transect. Record information on data sheets or electronically in PDA. Use a meter-long stick or rod to determine the 1-meter width on each side of the transect. Each belt transect survey encompasses 100 m².
- When collecting additional information on woody plant and cactus density, count any woody plant stems and cactus stems within the 100-m² area and record by species. Record on data sheets or electronically in PDA.

3.2 Point Intercept Transects

Purpose: This method is used to measure species cover and frequency. Frequency is measured when more than one transect is sampled in a given location.

Location: Across Rocky Flats according to information needs.

Time: Conducted during the height of the growing season, as feasible, or depending on information needs.

Equipment needed: Metric measuring tape (at least 50 m long), notebook or data sheets, pens, a 6-millimeter-diameter rod at least 2.0 m in length, rebar or some type of stakes to mark transect endpoints, PDA.

- Locate transect locations. This type of monitoring is typically conducted on the same transect lines used for the belt transects.
- Using a measuring tape, lay out a straight, 50-m transect line.
- If needed, use stakes or rebar to mark transect endpoints. Pin flags can be used to secure measuring tape in place so tape can be stretched and flattened out to mark transect.
- Starting at 0.5 m and ending at 50 m, drop the rod vertically at half-meter intervals on the right side of the tape. (100 hits per transect).
- Hold the rod vertically.
- Record foliar vegetation hits (defined as a portion of a plant touching the rod) by species in three categories as defined by height and growth form. Record the topmost hit of each growth form by species. The growth forms measured will include herbaceous, woody <2 m in height, and woody >2 m in height.
- Record basal (ground) hits according to the type of material the rod hits at the ground surface. Categories include bare ground, rock (pebbles or rocks greater than the rod diameter), water, litter (dead vegetation matter, erosion control matting, straw), or vegetation hit. Record basal vegetation hits by species only if the rod is touching the stem or crown of the plant where the plant enters the ground.
- Record basal hits and foliar hits separately by species or category (for basal hits) for separate analysis. Record on data sheets or electronically in PDA.

3.3 Quadrat Sampling

Purpose: This method determines species richness, cover, frequency, and plant density.

Location: Across Rocky Flats according to information needs.

Time: Conducted during the height of growing season or when the species of interest is at maximum growth.

Equipment needed: Metric measuring tape (at least 50 m long), quadrat frame (0.5 m², 1 m², or other size if preferred), notebook or data sheets, pens, PDA.

- Locate quadrat. If transects are used to place quadrats, place the edge of the quadrat next to the measuring tape with the lower left corner located at the random number location along the measuring tape. If transects are not used, random coordinates may be located in the field for sampling using a GPS unit with coordinates generated in the GIS or by some other random method.
- For species richness, record all plant species rooted within the quadrat. Record on data sheets or electronically in a PDA. Calculate species frequency as the number of quadrats within which a species occurred divided by the total number of quadrats sampled.
- For species cover, estimate and record the visual cover of each species or categories of species (e.g., graminoids, forbs) in the quadrat. Record on data sheets or electronically in a PDA. Visually estimate the cover using one of the following cover class systems or estimate to the nearest percent:

1 = <5%		1 = <5%
2 = 6–25%	or	2 = 6–25%
3 = 26–50%		3 = 26–50%
4 = 51–75%		4 = 51–75%
5 = >75%		5 = 75–95%
		6 = 96–100%

Note: An alternate cover class system may be used if desired for a specific project. Record the cover class used in the field notebook, or specify in the field sampling plan, or document in the summary report.

- Record plant density as the number of plants or stems of a species rooted within the quadrat. Record on data sheets or electronically in a PDA. **Note:** If the quadrat is not 1 m² in size, convert the density to the number of plants/stems per square meter.

3.4 Vegetation Profile Board

Purpose: This method provides a measurement of vertical vegetation density and is used primarily as a measure for Preble's mouse habitat along the riparian corridors, where a measure of the vertical vegetation density is important.

Location: Across Rocky Flats as needed.

Time: Conducted during the height of the growing season.

Equipment needed: 1.0-m² vegetation profile board (graduated by decimeters), notebook or data sheets, pens, PDA.

- Position the vegetation profile board upright at the selected location.
- Record a total of four measurements (offset by 90°) at each location. Read each measurement facing perpendicular to a side of the board.
- Read the vegetation profile board at a distance of approximately 10 m from the board itself at a height of approximately 1.0 meter (i.e., the level of the top of the board).
- Record the amount of the vegetation profile board covered by vegetation. Determine this value by counting the number of squares that are covered by vegetation. Add together portions of squares not completely covered and estimate the total vegetation cover. Take this measurement from all four sides of the board. Record on data sheets or electronically in a PDA. Average these values to get the average vertical herbaceous cover for that location.

4.0 General Wildlife Monitoring

4.1 Boreal Chorus Frog Vocalization Survey

Purpose: This survey is used to document population trends and distribution of boreal chorus frogs (*Pseudacris triseriatus*) on site. The survey is used as a tool to detect change in the health of the Rocky Flats aquatic ecosystem.

Location: Figure 1 shows the frog vocalization survey locations that have been used in the past at Rocky Flats. Coordinates of all locations are in the GIS database for Rocky Flats.

Time: Conducted in late April to early May, when frogs are most likely to be calling. Surveys will be conducted after water temperatures have reached 10 °C (50 °F). Surveys will begin about dusk and should be completed within 2 to 3 hours after sunset.

Equipment needed: Map of survey locations, coordinates (if needed), GPS unit (if needed), notebook, data sheets, pens, anemometer, two thermometers (Celsius), flashlights, watch, vehicle, insect repellant, frog call recordings/tape recorder/CD player (if needed).

- Drive to each sample location. After arriving at each sample location, wait one minute before beginning the survey.
- After the one-minute adjustment period, listen for boreal chorus frog vocalizations for 3 minutes.
- Categorize vocalizations using one of the following indexes:
 - 0** = No calling heard.
 - 1** = Individuals can be counted; calls not overlapping, there is space between calls.
 - 2** = Calls of individuals are distinguishable, but some calls overlap.
 - 3** = Full chorus; numerous frogs can be heard; calls are constant, continuous, and overlapping.
- Record the following at each location (where possible): air temperature (°C), water temperature (°C), wind speed (miles per hour), cloud cover, precipitation, and noise interference.
- Use an anemometer to record wind speed.
- Record cloud cover on a scale of 0 to 8, where 0 = no clouds, 4 = 50% cloud cover, and 8 = 100% cloud cover. Estimate intermediate levels.
- Record noise interference (from cars, nearby sampling equipment, etc.) as **Low**, **Medium**, **High**, or **None**.
- Document the species and the vocalization index of any other frog or toad species present at each location.

4.2 Circle Plot Bird Surveys

Purpose: These surveys document bird species richness, diversity, and density. This could be used to document how bird populations are changing in the former Industrial Area (IA) compared to the interface (IA/grassland), and reference areas (native grassland) as the revegetation in the IA progresses after physical completion of cleanup.

Location: Figure 2 shows previously used bird circle plot locations. New plots can be established as needed. Each bird plot is 100 m in diameter. Of the plots previously used, eight are located in the IA, eight are in the interface area, and eight are in the reference area. Coordinates of all locations are maintained in the GIS database for Rocky Flats.

Time: Each sample point is sampled once a week during the month of June (four times total), between sunrise and 10:30 a.m.

Equipment needed: Notebook or data sheets, pens, rebar, wooden stakes (1.0 m in length), flagging, pin flags, watch, binoculars, bird field guide, list of bird species at the site.

- Visit or mark the plots before starting the surveys to make locating the center points easier.
- Using GPS coordinates, locate the center point of each circle plot. The center points were originally marked with rebar but may need to be remarked. Each point should be marked so that it is visible above the height of the surrounding grass.
- On day of survey, stand at the center point of the circle where there is an unobstructed view of the entire plot.
- While approaching the plot and center point, record any birds flushed from within the circle plot as “in the plot at start.” Record the species and number of individuals flushed from the 100-m-diameter plot at the arrival.
- On arriving at the center point, stand still for one minute, then start the 10-minute survey.
- Record bird observations in the following ways during the 10-minute survey:
 - Include in the “in plot tally” category any species seen or heard in a stationary location within the 100-m-diameter circle during the survey.
 - Include in the “fly-ins tally” category species (except swallows, swifts, and raptors) entering the 100-m-diameter circle during the 10-minute survey.
 - Use the “on-wing tally” category only for swallows and swifts. The tally in this field will include birds entering the plot for the first 5 minutes and the last 4 minutes of the survey. Enter a one-minute tally of the 6th minute “on-wing tally” observations for these species into the “On-Wing 1-Minute” field. This category was created when the Industrial Area was present, and numerous swallows were constantly flying in and out of the plot during the 10-minute period, and it was difficult to keep track or know whether they had been counted previously. It is probably no longer necessary to track birds in this category.
 - Record raptors as being in the plot if they occur within 200 m of the center point of the plot (400-m-diameter circle). If they are seen or heard within 200 m of the center point, record them in the appropriate field.
 - Record any bird species seen or heard within 200 m of the plot center (400-m-diameter circle) throughout entire 10 minute survey in the “SpecCode” column. However, list the number of these bird observations in the other columns only if they fall within the appropriate distances as outlined above.

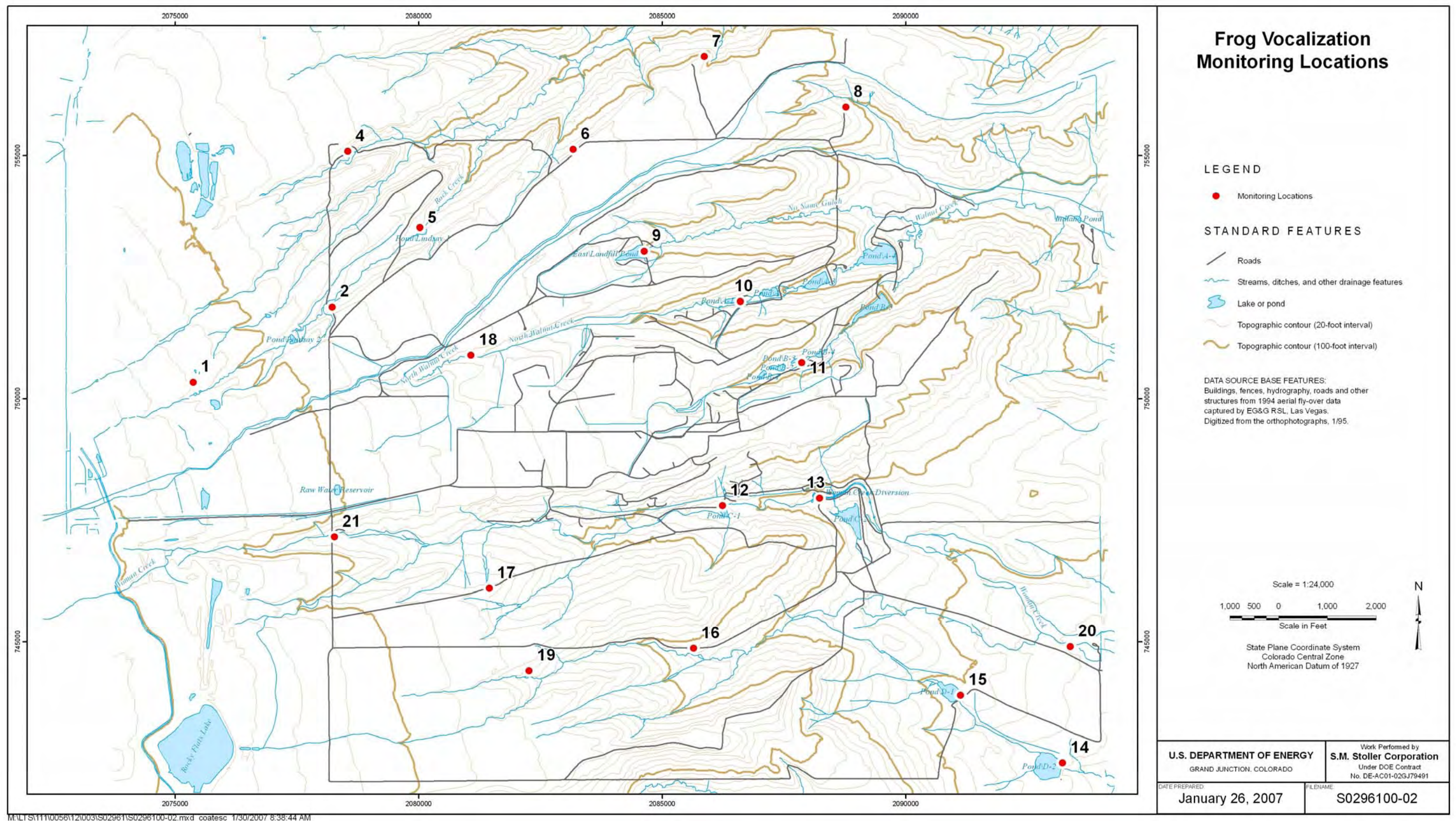


Figure 1. Frog Vocalization Monitoring Locations

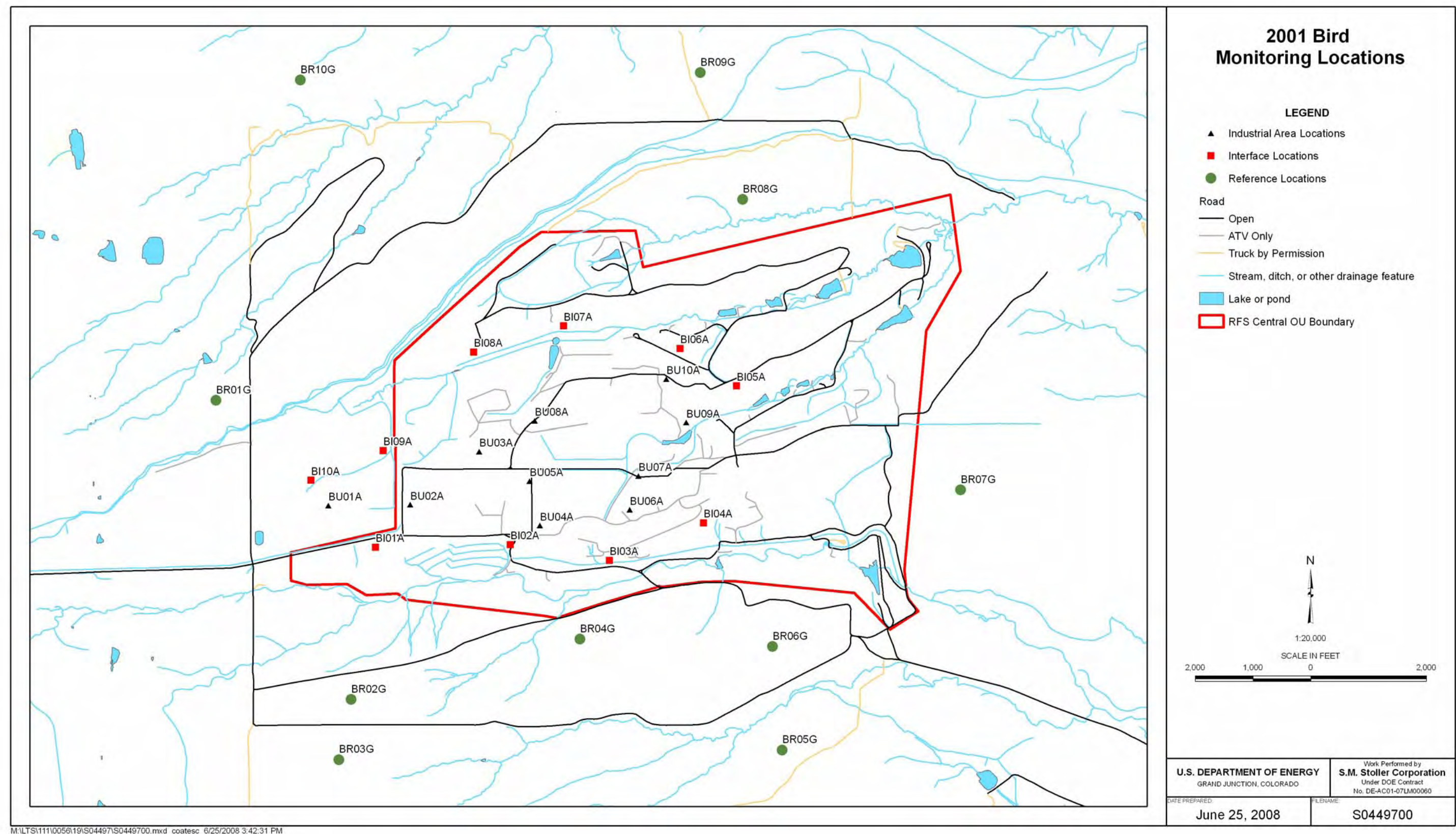


Figure 2. 2001 Bird Monitoring Locations

4.3 Small Mammal Trapping

Note: Obtain all appropriate federal, state, and local permits or approvals before beginning this activity. For trapping the Preble's meadow jumping mouse (PMJM), all trapping activities must conform to the U.S. Fish and Wildlife Service's *Preble's Meadow Jumping Mouse Survey Guidelines*, April 2004 revision or most recent version.

Purpose: This method is used to determine and monitor small mammal species population and composition at different locations. This method may also be used to evaluate changes as vegetation becomes reestablished at disturbed areas at Rocky Flats.

Location: Sitewide.

Time: Typically conducted in spring and late summer.

Equipment needed: Sherman small mammal live traps, GPS unit, sweet feed for bait, gallon plastic zip bags, Pesola spring scales, camera (digital or 35 millimeter), raccoon traps and peanut butter for bait, field notebook or trapping forms, pens, cotton or wool fiber balls for nesting material in traps during cooler times, latex gloves, leather gloves, and any other required personal protective equipment.

- Choose trapping sites at random or predetermined locations on the basis of information needs and requirements.
- Use a transect, "web" design, or other appropriate pattern to lay out the trapline. Traplines typically consist of 50 or 100 traps or more depending on the information needs.
- Space the traps approximately 5 m apart (may be modified on the basis of design requirements).
- After positioning the trapline, use a GPS to record the endpoints and the locations of the traps. These data will be added to the Rocky Flats GIS database.
- Determine the length of time the traps will be baited and run according to the design requirements of the study.
- Bait the traps with sweet feed and nesting material, and set after heat of day in the evening. After the first night of trapping, raccoon traps may need to be placed throughout the trapline if many of the traps were disturbed by animals during the night.
- Always check the baited and set traps the following morning before the heat of the day. After checking the traps, close them so that no animals become trapped during the heat of the day.
- When checking the traps, handle all animals with two layers of gloves—leather first, then latex on top.
- Observe captured small mammals by placing them in 1-gallon plastic zip bags initially. Wear the leather-plus-latex gloves to take the animals out of the bag for additional observation or to make the appropriate measurements.
- Record the species, sex, age (adult/juvenile), any breeding activity (e.g., lactating, pregnant) for all species captured.

- Gather additional data if any PMJM are captured. See Small Mammal Trapping (PMJM) methods.
- Release all animals near their capture location as soon as possible after completing measurements.
- Close all empty un-sprung traps.
- After the trapping session is complete, collect and disinfect all traps before storage.

4.4 Prairie Dog Surveys

Note: Prairie dog relocations require a prairie dog relocation permit from the Colorado Division of Wildlife.

Purpose: This survey is used to document the location and distribution of prairie dogs on site.

Location: Sitewide.

Time: Best conducted when prairie dog colonies are most visible during the year.

Equipment needed: Notebook or data sheets, pens, binoculars, maps, GPS unit.

- Determine the extent of active prairie dog colonies either by visually estimating and drawing the colony on a map or by using a GPS unit to map the extent while walking around the perimeter of the colony. If needed, each prairie dog hole can be mapped with a GPS to determine the overall extent of the colony.
- Collect any other information such as vegetation cover, weediness, and species richness, as necessary.
- Prairie dog counts may be made by observing the colony with binoculars from a distance and recording the number of animals observed.
- These data can be used to compare prairie dog abundance and colony present/size to that of previous years. These data may become important if prairie dogs begin to establish colonies in undesirable locations such as the Present Landfill Cover, Original Landfill Cover, 903 Pad and Lip Area, and others.

4.5 Deer Count Survey

Purpose: The deer count survey documents the distribution and population size of mule deer and white-tailed deer on site.

Location: Sitewide.

Time: Conducted in the winter, typically December or January when snow is on the ground, deer are most visible, and sex of the deer is most distinguishable.

Equipment needed: Vehicle, field notebook or data sheets, pens, binoculars, map, PDA.

- Conduct this driving survey on all Rocky Flats roads. Most areas are visible from roads or with binoculars.
- Document the locations of deer observations on a map of Rocky Flats.
- Record the following for any deer sightings:
 - Date
 - Time
 - Species
 - Location on map
 - Main activities of individual or group
 - The dominant vegetation community where the animal is located.
 - Number of males, females, and young of the year (where distinguishable)

5.0 Specific Vegetation Monitoring (Special Projects)

5.1 Wetland Monitoring and Delineation Methods

Purpose: This method is used to monitor and delineate wetland vegetation reestablishment and growth.

Location: Sitewide as needed.

Time: Conducted during the height of the growing season.

Equipment needed: GPS unit, field notebook or U.S. Army Corps of Engineers (USACOE) wetland delineation data sheets, PDA, GPS unit, pens, camera, pin flags, site wetland indicator species list, site plant species list, plant field guides, photo-point coordinates or maps, previous photo-point photographs.

Wetland Delineation: Follow the 1987 USACE *Wetlands Delineation Manual*, or current accepted methods, for delineation.

Qualitative Wetland Evaluation:

- Use this evaluation as qualitative wetland assessments to determine the status of the wetland reestablishment and whether management actions are warranted.
- Photograph wetlands from previously established wetland photo-points. Use GPS coordinates, maps, and previous photos to line up and retake photographs.
- Make a list of all plant species found growing within the wetland boundary.
- Visually estimate the cover of each recorded plant species across the entire wetland. An alternative method is to randomly locate quadrats and follow the quadrat methodology for listing species and estimating cover. Then combine the quadrat data and determine the overall species list and cover values for each species.
- Using a GPS unit, map the perimeter of the potential wetland (remember, this is not an official delineation; this is just for an annual record of where the edge was thought to be). This information can then be used to determine if the wetland is establishing appropriately and to estimate how much mitigation acreage may be expected to be achieved.

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